

Patent

What is claimed is:

1. An optical apparatus for coherent detection of an input optical beam, the apparatus comprising:
 - 5 (a) a beam splitter for splitting the input optical beam into a first component and a second component, the optical beam having information content with a minimum signal frequency component;
 - (b) an optical delay device arranged to receive the second component, the optical delay device imposing an intentional delay in the second component of the input optical beam;
 - 10 (c) an adaptive beam combiner coupled to receive
 - (i) the second component with a delay imposed thereon by the optical delay device; and
 - (ii) the first component from the beam splitter; the adaptive beam combiner having two exiting optical components, a first exiting optical component being representative of the difference of the first and second components received thereby and a second exiting optical component being representative of the sum of the first and second components received thereby; and
 - 15 (d) a detector arrangement for receiving and detecting the first and second exiting components from the adaptive beam combiner.
- 20 2. The optical apparatus of claim 1 wherein the input optical beam is provided from a source comprising:
 - (e) a probe laser;
 - (f) a workpiece under test which is subjected to an ultrasonic excitation pulse;
 - 25 (g) a beam director for receiving a laser beam from the probe laser and directing a first component of the laser beam towards said workpiece and directing a second component, together with the first component as reflected from the workpiece, to said beam splitter;
 - (h) a quarter wave plate disposed in the path of the first component of the laser beam; and
- 30 wherein the first component of the laser beam corresponds to the first component of

the optical beam and wherein the second component of the laser beam corresponds to the second component of the optical beam.

3. The optical apparatus of claim 1 wherein the delay imposed by the optical delay device is greater than an inverse of the minimum signal frequency component.

4. The optical apparatus of claim 1 wherein the optical delay device is a length of optic fiber.

10 5. The optical apparatus of claim 1 wherein the input optical beam is generated by a transmitter of an optical communications system.

15 6. A method for detecting sonic vibrations in a test material having a test surface comprising:

(a) generating a beam of light having a wavelength;

(b) splitting said beam into a first beam and a second beam;

(c) directing said first beam onto said test surface to be scattered by said test surface

with data having a minimum signal frequency component;

20 (d) delaying the second beam by a period of time which is greater than an inverse of the minimum signal frequency component;

(e) directing at least a portion of said scattered first beam and the delayed second beam on an adaptive beam splitter; and,

(f) directing said first and second beams onto photodetectors to result in an electrical output signal that is representative of the vibrating test surface.

25 7. The method of claim 6 wherein said generated beam of light is a polarized coherent light beam and wherein said first and said second beams are co-propagating and co-polarized when impinging said adaptive beam splitter.

30 8. The method of claim 7 wherein said first and said second beams are not co-

propagating and co-polarized immediately after the second beam is delayed by the delaying step but wherein the first and seconds beams are independently subjected to a polarization correcting step to ensure that each of said first and second beams has the same polarization as the other beam.

5

9. The method of claim 6 wherein said sonic vibrations are small vibrational surface deflections.

10. The method of claim 9 wherein said sonic vibrations are on the order of ultrasonic 10 surface vibrations.

11. An apparatus for sensing sonic vibrations on a material having a test surface, comprising:

(a) a light generating source for generating a coherent, co-polarized beam of light having a predetermined wavelength;

(b) a beam splitting apparatus for receiving said generated light beam, splitting said generated light beam into at least a first light beam and a second light beam, and for directing said

first light beam to a test material test surface capable of at least scattering said first beam with data having a minimum signal frequency component;

(c) an optical delay device for delaying at least one of said first and second beams with a delay which is greater than an inverse of the minimum signal frequency component;

(d) an adaptive beam splitter having a receiving surface for receiving at least a portion of said scattered first light beam at a first angle relative to said receiving surface, and for receiving said second light beam at a second angle relative to said receiving surface which second angle is different from said first angle, for interfering said first and said second beams to introduce a phase shift difference between said first and said second beams, and for producing co-propagating light waves comprising at least a portion of said first beam and at least a portion of said second beam received by said receiving surface; and,

30 (e) photodetectors for receiving co-propagated light beams from said adaptive beam

splitter means and for producing an electrical output signal that is representative of the vibrating test surface.

12. The apparatus of claim 11 further including a polarization correcting apparatus to
5 ensure that each of said first and second beams has the same polarization as the other beam
when impinging said adaptive beam combiner.

13. The apparatus of claim 12 wherein the polarization correcting apparatus includes a
polarization beam splitter and a 90° beam rotator arranged in series in paths associated with
said first and second light beams.